U.S.C.G. Merchant Marine Exam

Chief Engineer – OSV

Q684 Electrical-Electronic-Control Engineering

(Sample Examination)
Choose the best answer to the following Multiple Choice Questions.

1. Two AC generators of the same capacity are operating in parallel. One with a zero speed droop setting and the other with a 5% speed droop. If its capacity is not exceeded, what will be the characteristic of the unit whose governor has the zero speed droop setting?

   o (A) it will assume the smaller share of the load
   o (B) it will have poor power response
   • (C) it will maintain the frequency of the system
   o (D) it will have poor sensitivity characteristics

   If choice C is selected set score to 1.

2. As shown in figure "B" of the illustration, what is the purpose of the synchronous compensator?
Illustration EL-0133

   o (A) provide additional active power to the mains beyond the capability of the frequency converter
   o (B) provide additional reactive power to the mains beyond the capability of the frequency converter
   • (C) provide reactive power to the mains as the frequency converter has the ability to provide only active power
   o (D) provide active power to the mains as the frequency converter has the ability to provide only reactive power

   If choice C is selected set score to 1.

3. To prevent shaft currents in an alternator, the outboard bearing shell or outboard bearing pedestal is insulated. If the methodology used is the insulated bearing pedestal, how is the pedestal insulation evaluated?

   o (A) Measuring the resistance between the bearing pedestal and the bearing bedplate of a disassembled machine with a digital multimeter setup as an ohmmeter.
   • (B) Measuring the resistance between the bearing pedestal and the bearing bedplate of a disassembled machine with a 500-Volt megohmmeter.
   o (C) Measuring the resistance between the bearing pedestal and the bearing bedplate of an assembled machine with a 500-Volt megohmmeter.
   o (D) Measuring the resistance between the bearing pedestal and the bearing bedplate of an assembled machine with a digital multimeter setup as an ohmmeter.

   If choice B is selected set score to 1.
4. In addition to insulating the outboard bearing pedestal to prevent shaft currents in an alternator, what else must be insulated?

- (A) Exciter bearings that make a connection to the alternator outboard bearing pedestal must also be insulated. No such requirement exists for lube oil piping connections.
- (B) The lube oil piping connections that make a connection to the alternator outboard bearing pedestal must also be insulated. No such requirement exists for exciter bearings.
- (C) BOTH lube oil piping connections AND exciter bearings that make a connection to the alternator inboard bearing pedestal must also be insulated.
- (D) BOTH lube oil piping connections AND exciter bearings that make a connection to the alternator outboard bearing pedestal must also be insulated.

*If choice D is selected set score to 1.*

5. As shown in the illustrated alternator protection scheme diagram, what device provides the input to the overcurrent inverse time relay "OCIT", the overcurrent instantaneous trip "OC (inst.)", and the negative phase sequence relay "NPS"? Illustration EL-0067

- (A) infrared sensors
- (B) current transformer
- (C) potential transformer
- (D) thermal monitor sensors

*If choice B is selected set score to 1.*

6. As shown in the illustrated diagnostic setup for locating a shorted field coil of a ten-pole salient pole alternator, if 240 VAC/60 Hz is applied across the brushes, what would be the voltage drop across field coil No.4 if that field coil had shorted turns and the other field coils were free of shorts? Illustration EL-0202

- (A) 17 VAC
- (B) 24 VAC
- (C) 25 VAC
- (D) 32 VAC

*If choice A is selected set score to 1.*

7. As shown in the illustration, what type of motor and motor starter are featured? Illustration EL-0137

- (A) reversing squirrel cage induction motor with reduced voltage autotransformer starting
- (B) non-reversing squirrel cage induction motor with reduced voltage primary reactor starting
- (C) non-reversing squirrel cage induction motor with reduced voltage autotransformer starting
- (D) reversing squirrel cage induction motor with across-the-line starting

*If choice C is selected set score to 1.*
8. With what kind of starting equipment are most three-phase induction motors of five horsepower or less started?
   - (A) reactor starters
   - (B) autotransformer starters
   - (C) resistor starters
   - (D) across-the-line starters

   If choice D is selected set score to 1.

9. Utilizing the instructions and data provided in the illustration, what size overload relay heater would be the proper selection for a motor with the nameplate data shown? Assume the motor operates at sea level and that the motor and its starter share the same ambient temperature. Illustration EL-0171
   - (A) G30T19
   - (B) G30T20
   - (C) G30T21
   - (D) G30T22

   If choice B is selected set score to 1.

10. Which of the following describes the action when the handle is moved to the "start" position of a drum-type motor controller used with a compound wound DC motor?
   - (A) Reduced voltage is supplied to the shunt field, series field, and armature.
   - (B) Full line voltage is supplied to the shunt field, and reduced voltage is supplied to the series field and the armature.
   - (C) Full line voltage is supplied to the shunt and series fields, and reduced voltage is supplied to the armature.
   - (D) Full line voltage is supplied to the shunt field, series field, and armature.

   If choice B is selected set score to 1.

11. By what means should motor controller contacts be routinely cleaned?
   - (A) filing with a bastard file
   - (B) blowing with compressed air
   - (C) dressing with crocus cloth
   - (D) wiping with a clean dry cloth

   If choice D is selected set score to 1.
12. Using the catalog selection chart shown in Illustration EL-0180, determine the correct catalog number for a motor starter that meets the following criteria:

- NEMA: Open enclosure
- 3-pole: Rated at 45 continuous amperes
- Vertically mounted: Electronic overload relay-Ground fault feature set
- Reversing starter: Operating coil rated at 24 VAC/60 Hz

- (A) AE19GNVB5G045
- (B) AN19AN0A5E005
- (C) AN59GNVT5G045
- (D) CN16GNVT5G045

If choice C is selected set score to 1.

13. As shown in the illustration, what mechanism will disconnect the motor from the line in case of a sustained motor overload? Illustration EL-0080

- (A) transformer secondary fuses FU6 and FU7
- (B) overload relay heaters and overload relay NC contacts (OL)
- (C) disconnect switch fuses FU1, FU2, and FU3
- (D) transformer primary fuses FU4 and FU5

If choice B is selected set score to 1.

14. If a digital multimeter is set up as shown in figure "A" of the illustration to test an AC contactor coil, what would the display read if the coil is open-circuited? Illustration EL-0214

- (A) 0.03 ohms
- (B) 22 ohms
- (C) OL ohms
- (D) 110 V

If choice C is selected set score to 1.

15. As shown in figure "A" of the illustrated propulsion motor variable speed drive, what statement is true? Illustration EL-0140

- (A) both the bridge rectifier and the controller inverter bridge are transistor controlled in terms of switching
- (B) the bridge rectifier is uncontrolled and the controller inverter bridge is thyristor controlled in terms of switching
- (C) the bridge rectifier is uncontrolled and the controller inverter bridge is transistor controlled in terms of switching
- (D) both the bridge rectifier and the controller inverter bridge are thyristor controlled in terms of switching

If choice C is selected set score to 1.
16. Which of the following is a disadvantage of electric drive propulsion systems?

- (A) The propeller speed and direction of rotation are easily controllable.
- (B) Main propulsion power may also be directed to ships electrical service distribution.
- (C) Propulsion motors are required along with electrical power generation machinery.
- (D) Location of electric power generation machinery is flexible.

*If choice C is selected set score to 1.*

17. As shown in figure "B" of the illustration, what statement is true concerning "regenerating" operation? Illustration EL-0162

- (A) by applying torque in the opposite direction of rotation direction, the motor briefly regenerates power back into the mains, which rapidly speeds up the motor
- (B) by applying torque in the same direction of rotation direction, the motor briefly regenerates power back into the mains, which rapidly slows down the motor
- (C) by applying torque in the opposite direction of rotation direction, the motor briefly regenerates power back into the mains, which rapidly slows down the motor
- (D) by applying torque in the same direction of rotation direction, the motor briefly regenerates power back into the mains, which rapidly speeds up the motor

*If choice C is selected set score to 1.*

18. How is the direction of rotation of the main propulsion motor in a modern AC propulsion drive system reversed?

- (A) reversing the direction of current flow in the armature
- (B) changing the direction of current flow in the motor's field winding
- (C) electronically changing the phase sequence of the voltages generated by the power converter
- (D) power directional relays

*If choice C is selected set score to 1.*

19. An AC diesel-electric drive ship with synchronous propulsion motors has the capability for power factor correction. If the power factor associated with the main power distribution including all motors is 0.7 leading, what statement is true?

- (A) The synchronous propulsion motors are normally excited.
- (B) The synchronous propulsion motors are under-excited.
- (C) The excitation status of the synchronous motor cannot be determined.
- (D) The synchronous propulsion motors are over-excited.

*If choice D is selected set score to 1.*
20. In addition to improper brush pressure or seating, what can result in excessive sparking at the brushes of a DC propulsion motor?

- (A) operating at continuously varying loads such as during maneuvering
- (B) reversed main field polarity with respect to the armature
  - (C) improper positioning of brush rigging outside the neutral plane
- (D) reversed armature polarity with respect to the field

*If choice C is selected set score to 1.*

21. What type of motor is generally used in DC propulsion drive systems?

- (A) differentially compounded
- (B) permanent magnet
  - (C) shunt wound
- (D) series wound

*If choice C is selected set score to 1.*

22. On an older two-generator, two-motor DC diesel-electric drive system as shown in the illustration, if both the A1 and A2 contactors are dropped out, both the S1 and S2 contactors are dropped out, and both the G1 and G2 contactors are pulled in, what is the configuration of the plant? Illustration EL-0141

- (A) The main propulsion generators provide power to the main propulsion motors, and the gas turbine generator provides power to the bow thruster motor as needed.
- (B) The gas turbine generator provides power to the main propulsion motors, and the auxiliary diesel-generator provides power to the bow thruster motor as needed.
- (C) The gas turbine generator provides power to the main propulsion motors and provides power to the bow thruster motor as needed.
- (D) The main propulsion generators provide power to the main propulsion motors, and the auxiliary diesel-generator provides power to the bow thruster motor as needed.

*If choice A is selected set score to 1.*

23. How is speed control of a DC propulsion motor accomplished?

- (A) the use of a load-commutated inverter
- (B) adjusting the output frequency of the electric power source
- (C) the use of static power converters
  - (D) adjusting the input voltage to the motor

*If choice D is selected set score to 1.*
24. Refer to the two-generator, two-motor, DC diesel-electric drive propulsion system simplified schematic shown in the illustration. While in two-generator, two-motor operation, which of the following conditions would cause the propulsion shaft speed to be approximately one-half the desired speed? Illustration EL-0141

- (A) The field winding of one of the propulsion motors is open-circuited.
- (B) The armature winding of one of the propulsion motors is open-circuited.
- (C) The field winding of one of the propulsion generators is open-circuited.
- (D) The armature winding of one of the propulsion generators is open-circuited.

*If choice C is selected set score to 1.*

25. Due to the operating characteristics of the system, time lag fuses (or dual-element fuses) are necessary for use in what types of circuits?

- (A) motor starting circuits
- (B) general alarm circuits
- (C) emergency lighting circuits
- (D) main lighting circuits

*If choice A is selected set score to 1.*

26. When the operating handle of a molded-case circuit breaker is in the mid-position, what does this indicate?

- (A) the circuit breaker has tripped
- (B) the circuit breaker is switched on
- (C) the circuit breaker is switched off
- (D) the circuit breaker has been reset

*If choice A is selected set score to 1.*

27. What is the purpose of the device labeled "Man-Auto Sw." in the illustrated switchboard? Illustration EL-0003

- (A) to shift the governor control from manual to automatic/zero droop or vice versa
- (B) to enable the operator to read the field voltage on device "Volt. Reg. Adj. Pot." or device "Man. Volt. Adj. Rheo."
- (C) to supply regulated control power to the switchboard
- (D) to shift from the automatic voltage regulator to manual voltage control or vice versa

*If choice D is selected set score to 1.*
28. Why is it necessary to perform periodic testing of correctly rated and properly installed circuit breakers?

- (A) to insure they will continue to provide the original degree of protection
- (B) to insure they do not exceed their interrupting capacity
- (C) to insure they can trip faster as they increase in age
- (D) to insure they will be able to withstand at least 125% of applied voltage

*If choice A is selected set score to 1.*

29. Which of the following procedures should be used to maintain a large electric motor during periods of inactivity?

- (A) A thin layer of air-drying varnish should be applied on the windings.
- (B) Space heaters should be used to prevent condensation of moisture.
- (C) Spraying a solvent periodically to remove carbon dust.
- (D) Compressed air should be blown over areas where dust is deposited.

*If choice B is selected set score to 1.*

30. In testing a hand cranked megger prior to use, what statement is true?

- (A) With the test leads shorted or open, the pointer should go to infinite ohms.
- (B) With the test leads shorted, the pointer should go to infinite ohms, and with the tests leads open, the pointer should go to zero ohms.
- (C) With the test leads shorted, the pointer should go to zero ohms, and with the tests leads open, the pointer should go to infinite ohms.
- (D) With the test leads shorted or open, the pointer should go to zero ohms.

*If choice C is selected set score to 1.*

31. As shown in figure "D" of the illustrated digital power meter, what type of single-phase load is under test for power measurement? Illustration EL-0256

- (A) a resistive-capacitive load
- (B) an inductive-resistive load
- (C) a purely resistive load
- (D) a purely inductive load

*If choice B is selected set score to 1.*
32. As shown in figures "B" and "C" of the illustration, what should be the switch position and which test lead terminal jacks should be used if your intent is to measure AC currents anticipated as high as 5 amps? Illustration EL-0047

- (A) switch position "1" and terminal jacks "1 and 4"
- (B) switch position "6" and terminal jacks "1 and 4"
- (C) switch position "7" and terminal jacks "1 and 2"
- (D) switch position "7" and terminal jacks "2 and 4"

*If choice D is selected set score to 1.*

33. How should the shunt used in an ammeter be connected?

- (A) in series with the load and in parallel with the meter movement
- (B) in parallel with the load and in parallel with the meter movement
- (C) in series with the load and in series with the meter movement
- (D) in parallel with the load and in series with the meter movement

*If choice A is selected set score to 1.*

34. To properly use a clamp-on type ammeter to check current flow, what must be done FIRST?

- (A) connect the voltage test leads to the appropriate terminals
- (B) short the test leads and calibrate the instrument to zero
- (C) hook the jaws of the instrument around the insulated single conductor
- (D) de-energize the circuit to allow connection of the instrument in series

*If choice C is selected set score to 1.*

35. Under what circumstance would a hand-held portable phase sequence indicator be used should the main switchboard mounted fixed phase sequence indicator be inoperative?

- (A) paralleling alternators
- (B) preparing to make the shore power connection
- (C) replacing a defective solenoid
- (D) installing a new synchroscope

*If choice B is selected set score to 1.*

36. Which of the illustrated resistors represents the schematic symbol shown in figure "B"? Illustration EL-0021

- (A) figure "4"
- (B) figure "6"
- (C) figure "10"
- (D) figure "11"

*If choice C is selected set score to 1.*
37. Which of the following electrical schematic symbols represents a normally closed flow switch? Illustration EL-0059

- (A) 6
- (B) 7
- (C) 11
- (D) 14

*If choice A is selected set score to 1.*

38. What is the maximum current allowed to be drawn from the secondary of a 2 kVA step-down transformer with a turns ratio of four to one if connected across a 440 volt line?

- (A) 1.1 amps
- (B) 4.5 amps
- (C) 18.1 amps
- (D) 22.7 amps

*If choice C is selected set score to 1.*

39. To check the three line fuses protecting a three-phase motor using a multimeter set up as a voltmeter, what should be done FIRST?

- (A) make sure the motor is operating at full load to guard against a false reading
- (B) place the leads across the bottom ends of the fuses
- (C) place the leads across the "hot" ends of the fuses
- (D) place the starter in the "stop" position

*If choice D is selected set score to 1.*

40. If a digital multimeter is set up as shown in figure "A" of the illustration, what would be displayed on the screen if the fuse being tested is blown? Illustration EL-0210

- (A) OL volts
- (B) 0.001 ohms
- (C) 470 ohms
- (D) OL ohms

*If choice D is selected set score to 1.*

41. In the lighting distribution circuit shown in the illustrated lighting panel L110 of the illustration, if all circuit breakers are closed and due to a problem with the relevant feeder circuit breaker, there is a loss of power on the incoming phase A, which of the following statements is true? EL-0013

- (A) Half of the passageway lighting circuits on the 01 deck would lose power.
- (B) All of the accommodation lighting circuits on the 01 deck, starboard side would lose power.
- (C) All of the receptacles in the laundry would lose power.
- (D) Half of the accommodation lighting circuits on the 01 deck, port side would lose power.

*If choice D is selected set score to 1.*
42. What does section "C" of the circuit shown in the illustration function as? Illustration EL-0085

- (A) a voltage regulator
- (B) a filter
- (C) a rectifier
- (D) a voltage transformer

*If choice B is selected set score to 1.*

43. As shown in figure "A" of the illustration, what type of converter unit is represented? Illustration EL-0240

- (A) de-multiplexer
- (B) multiplexer
- (C) analog to digital converter
- (D) digital to analog converter

*If choice C is selected set score to 1.*

44. In process control terminology, continuously variable values which change without distinct increments, such as temperature, pressure, or level are correctly referred to as what type of values?

- (A) bumpless values
- (B) digital values
- (C) analog values
- (D) binary values

*If choice C is selected set score to 1.*

45. Which of the listed conditions describes the effect on intrinsic semiconductor operation as a result of a temperature increase?

- (A) Inductive reactance will decrease
- (B) Conductivity will increase
- (C) Capacitive reactance will decrease
- (D) Resistivity will increase

*If choice B is selected set score to 1.*

46. What is the functional purpose of a heat sink, as frequently used with transistors?

- (A) to compensate for excessive doping
- (B) to decrease the forward current
- (C) to prevent excessive temperature rise
- (D) to increase the reverse current

*If choice C is selected set score to 1.*
47. If a digital multimeter is set up as shown in figure "B" of the illustration to test a capacitor, what would the display read if the capacitor was functioning properly? Illustration EL-0213

- (A) the charging voltage would be displayed which will initially be low and gradually rise to the internal battery voltage
- (B) initially a very high ohmic value will be displayed (OL ohms), followed by a gradual drop in resistance until a very low value is displayed
- (C) initially a very low ohmic value will be displayed, followed by a gradual rise in resistance until a very high value is displayed (OL ohms)
- (D) the actual capacitance value of the capacitor will be displayed which should be within the tolerance range of the capacitor

*If choice D is selected set score to 1.*

48. An ohmmeter used to test for front-to-back resistance of a PN junction diode should produce roughly what ratio?

- (A) 100:1
- (B) 500:1
- (C) 1000:1
- (D) 5000:1

*If choice A is selected set score to 1.*

49. What problem with a printed circuit board may resolve itself once a board is removed from its edge card connector and then reinstalled?

- (A) Discolored or darkened components
- (B) Leaking components
- (C) Corroded pin connectors
- (D) Open traces or broken connections

*If choice C is selected set score to 1.*

50. Some shipboard high voltage systems have the neutral point of the generators bonded to the ship's hull with a neutral grounding resistor. What is the purpose of this resistor?

- (A) To completely eliminate ground fault current
- (B) To minimize the magnitude of the ground fault current
- (C) To prevent nuisance ground fault trips
- (D) To maximize the magnitude of the ground fault current

*If choice B is selected set score to 1.*
51. For the purposes of shipboard practice, voltages above what threshold would be considered high voltage?

- (A) 440 VAC
- (B) 1000 VAC
- (C) 4160 VAC
- (D) 6600 VAC

*If choice B is selected set score to 1.*

52. In order for a live-line tester to be used to test and prove dead a high voltage circuit, what must be done to verify the ability of the tester to detect a voltage?

- (A) The live-line tester should be checked by connecting to a known high voltage source before and after the circuit to be worked upon is tested.
- (B) The live-line tester need not be checked prior to testing the circuit to be worked upon as long as it has not been declared inoperative.
- (C) The live-line tester should be checked by connecting to a known high voltage source only after testing the circuit to be worked upon.
- (D) The live-line tester should be checked by connecting to a known high voltage source only before testing the circuit to be worked upon.

*If choice A is selected set score to 1.*

53. When a high voltage system insulation test value is suspect or recorded during an annual survey, a polarization index test is performed. What is the polarization index?

- (A) The polarization index is the ratio of the insulation resistance taken at thirty minutes to the insulation resistance taken at one minute.
- (B) The polarization index is the ratio of the insulation resistance taken at ten minutes to the insulation resistance taken at one minute.
- (C) The polarization index is the insulation resistance taken at ten minutes.
- (D) The polarization index is the ratio of the insulation resistance taken at one minute to the insulation resistance taken at ten minutes.

*If choice B is selected set score to 1.*

54. Overheating is suspected in a high voltage bolted bus-bar joint. If the local continuity resistance is to be checked off-line after the necessary safety precautions have been taken, what instrument would be used for the resistance test?

- (A) A special high resistance tester (megohmmeter).
- (B) A special low resistance tester (microhmmeter).
- (C) A conventional ohmmeter.
- (D) Any of the above ohmmeters would be suitable.

*If choice B is selected set score to 1.*
55. Without the benefit of a specially designed enclosure window for thermographic analysis, what must be done to obtain accurate, but safe readings using infrared thermographic techniques?

- (A) The infrared camera recording is taken before de-energizing and isolating in accordance with safety procedures.
- (B) The infrared camera recording is taken immediately after de-energizing and isolating in accordance with safety procedures.
- (C) The infrared camera recording is taken after waiting a suitable period of time after de-energizing and isolating in accordance with safety procedures.
- (D) The infrared camera recording is taken while energized with the enclosure door open in accordance with safety procedures.

*If choice B is selected set score to 1.*

56. What statement is true concerning random access memory (RAM)?

- (A) RAM is non-volatile memory and the contents of RAM are lost when the power is removed.
- (B) RAM is non-volatile memory and the contents of RAM are not lost when the power is removed.
- (C) RAM is volatile memory and the contents of RAM are lost when the power is removed.
- (D) RAM is volatile memory and the contents of RAM are not lost when the power is removed.

*If choice C is selected set score to 1.*

57. What Ethernet cabling technology supports the greatest data transfer speeds?

- (A) Thick Ethernet
- (B) Gigabit Ethernet
- (C) Thin Ethernet
- (D) Fast Ethernet

*If choice B is selected set score to 1.*

58. If a computer display is flickering, how may this be remedied?

- (A) Increase the resolution bandwidth
- (B) Decrease the resolution bandwidth
- (C) Increase the refresh rate
- (D) Decrease the refresh rate

*If choice C is selected set score to 1.*
59. If a mechanical mouse of a computer workstation is operating erratically, what maintenance should be performed?
   ○ (A) Solvent should be sprayed onto the underside of the mouse.
   ○ (B) Remove the plastic surround on the underside of the mouse, and after removing the ball, mechanically clean the two wheels.
   ○ (C) Compressed air should be directed onto the underside of the mouse.
   ○ (D) Remove the plastic surround on the underside of the mouse, and after removing the ball, mechanically clean the limit switches.

   *If choice B is selected set score to 1.*

60. A very useful Windows utility for discovering or verifying IP addressing information of a network is "ipconfig". How is this utility program launched?
   ○ (A) It is run by clicking on the "ipconfig" icon in start menu or under programs.
   ○ (B) It is run from the command prompt screen by default by simply bringing up the command prompt.
   ○ (C) It is run from the command prompt screen by typing "ipconfig/all".
   ○ (D) It is run by clicking on the TCP/IP shortcut icon on the desktop.

   *If choice C is selected set score to 1.*

61. What is the name of a TCP/IP application run from the command prompt that sends datagrams once every second in the hope of an echo response from another machine (network device) being addressed to test network connectivity and to verify that TCP/IP is running?
   ○ (A) IPCONFIG
   ○ (B) PING
   ○ (C) TRACERT
   ○ (D) FTP

   *If choice B is selected set score to 1.*

62. According to the liquid crystal data display for the depth sounder shown in the illustration, what is the instantaneous depth currently being displayed? Illustration EL-0186
   ○ (A) 43.5 meters below the surface
   ○ (B) 43.5 meters below the transducer
   ○ (C) 47.5 meters below the surface
   • (D) 47.5 meters below the transducer

   *If choice D is selected set score to 1.*
63. As shown in the illustrated block diagram for a digitized echo sounding system, what statement is true concerning the function of the transducer? Illustration EL-0185

- (A) The transducer converts radio frequency (RF) electromagnetic energy to acoustical energy while receiving and converts the reflected acoustical energy back into RF electromagnetic energy while transmitting.
- (B) The transducer converts radio frequency (RF) electromagnetic energy to acoustical energy while transmitting and converts the reflected acoustical energy back into RF electromagnetic energy while receiving.
- (C) The transducer converts audio frequency (AF) electromagnetic energy to acoustical energy while receiving and converts the reflected acoustical energy back into AF electromagnetic energy while transmitting.
- (D) The transducer converts audio frequency (AF) electromagnetic energy to acoustical energy while transmitting and converts the reflected acoustical energy back into AF electromagnetic energy while receiving.

*If choice B is selected set score to 1.*

64. As shown in the illustrated adaptive digital steering control system functional block diagram and listed system interface signals table, what would the rudder order signal output voltage to the rudder servo amplifier be for a rudder order of 15 degrees right rudder, assuming left rudder signals are negative and right order signals are positive in polarity? Illustration EL-0191

- (A) -1.33 VDC
- (B) -3.75 VDC
- (C) +3.75 VDC
- (D) +5.0 VDC

*If choice C is selected set score to 1.*

65. As shown in the illustrated adaptive digital steering control system functional block diagram and listed system interface signals table, what would the rudder order signal output voltage to the rudder servo amplifier be for a rudder order of 20 degrees left rudder, assuming left rudder signals are negative and right order signals are positive in polarity? Illustration EL-0191

- (A) -2.25 VDC
- (B) -4.0 VDC
- (C) -5.0 VDC
- (D) +5.0 VDC

*If choice C is selected set score to 1.*

66. Before any work on electrical or electronic equipment is performed, which of the following precautions should be carried out?

- (A) Bypass the interlocks.
- (B) Secure and tag the supply circuit breaker in the open position.
- (C) Station a man at the circuit supply switch.
- (D) De-energize the applicable switchboard bus.

*If choice B is selected set score to 1.*
67. When performing an absence-of-voltage test before commencing repair work, at the minimum where must the absence-of-voltage test be performed?

- (A) At the point of contact where the work will take place
- (B) At the load side disconnect switch
- (C) At the main feeder circuit breaker
- (D) At the source disconnect branch circuit breaker

*If choice A is selected set score to 1.*

68. When a self-excited alternator's field has lost its residual magnetism due to a prolonged idle period, it will fail to produce a voltage. Flashing the field is the procedure used to restore the residual magnetism. Using a 12 volt storage battery, how is this performed?

- (A) The F+ and F- leads are disconnected from the alternator field. The F+ lead is connected to the negative terminal of the battery, and the F- lead is connected to the positive terminal.
- (B) The F+ and F- leads are disconnected from the alternator field. The F+ lead is connected to the positive terminal of the battery, and the F- lead is connected to the negative terminal.
- (C) The S+ and S- leads are disconnected from the alternator stator. The S+ lead is connected to the positive terminal of the battery, and the S- lead is connected to the negative terminal.
- (D) The S+ and S- leads are disconnected from the alternator stator. The S+ lead is connected to the negative terminal of the battery, and the S- lead is connected to the positive terminal.

*If choice B is selected set score to 1.*

69. Upon failure of the normal power supply, how is the emergency generator placed on the line to feed power to the emergency bus?

- (A) line connection feeder
- (B) main bus tie feeder
- (C) automatic bus transfer device
- (D) power failure alarm bus

*If choice C is selected set score to 1.*

70. While standing "at sea watch" onboard a modern rectified DC diesel-electric drive ship you notice the transformer core temperature slowly rising. What should be your FIRST action?

- (A) notify the bridge that you need to slow down
- (B) send the oiler to look for fires in the transformer
- (C) reduce load by tripping lighting circuits
- (D) check the transformer ventilation fans for proper operation

*If choice D is selected set score to 1.*
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Adapted for testing purposes only from HERMAN, Industrial Motor Control, 6th Edition
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Where R = Direction of Actual Rotation
T = Direction of Applied Torque

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General Instructions for Selection of Overload Relay Heater Elements:

1. Obtain full load current and service factor from motor nameplate of from motor manufacturer. Do not estimate full-load motor current from horsepower tables.
2. Determine if 1, 2, or 3 overload relays are needed.
3. Select proper heater from appropriate table according to class, size, type of enclosure and number of overload relays being used. Full load motor currents should be within the Min.-Max. ratings shown for the number of overload relays being used.
4. The tables apply only to standard, open type or totally enclosed fan-cooled, continuous duty motors (with a service factor of 1.15 and rated for 40 degrees C rise) in applications where motor and starter are located in the same ambient temperature. For applications of other motors with a service factor of 1, 50-55 degrees C rise, totally enclosed non-ventilated, explosion proof, or for installations where ambient temperatures of motor and starter are different, refer to Chart “A” for selection of overload heater units.

Chart A: Variations by Operating Conditions

<table>
<thead>
<tr>
<th>Motor continuous rating °C rise</th>
<th>Ambient temperature same at starter and motor</th>
<th>Ambient temperature higher at starter than at motor</th>
<th>Ambient temperature lower at starter than at motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5 service factor 40° C rise</td>
<td>As specified from tables</td>
<td>One size larger than specified for each 15° C difference</td>
<td>One size smaller than specified for each 15° C difference</td>
</tr>
<tr>
<td>1.0 service factor 50-55° C rise</td>
<td>One size smaller than for 1.15 service factor as above</td>
<td>One size smaller than for 1.15 service factor as above</td>
<td>One size smaller than for 1.15 service factor as above</td>
</tr>
</tbody>
</table>

Table 24: NEMA Size 6 for all Standard Enclosures

<table>
<thead>
<tr>
<th>Motor Current</th>
<th>Heater Cat. No</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>G30T19</td>
<td>142</td>
<td>157</td>
<td></td>
</tr>
<tr>
<td>G30T20</td>
<td>158</td>
<td>171</td>
<td></td>
</tr>
<tr>
<td>G30T21</td>
<td>172</td>
<td>188</td>
<td></td>
</tr>
<tr>
<td>G30T22</td>
<td>189</td>
<td>207</td>
<td></td>
</tr>
<tr>
<td>G30T23</td>
<td>208</td>
<td>229</td>
<td></td>
</tr>
</tbody>
</table>
EL-0180
Catalog Number Selection Chart

Example Catalog Number

A N 1 9 A N 0 A 5E 005

Device Type
A = Starter
C = Contactor
E = IEC
N = NEMA

Device Assembly Configurations
70 = Multi-speed
1 = Non-reversing
5 = Reversing

OLR Type
5 = Contact only-no overload relay
6 = Starter w/C306 bi-metallic OLR
9 = Starter w/C440 electronic overload

NEMA Enclosures
N = Open

Contactor Frame Size*

<table>
<thead>
<tr>
<th>Suffix</th>
<th>NEMA Size</th>
<th>Continuous Amperes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>00</td>
<td>9</td>
</tr>
<tr>
<td>B</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>D</td>
<td>1</td>
<td>27</td>
</tr>
<tr>
<td>G</td>
<td>2</td>
<td>45</td>
</tr>
<tr>
<td>K</td>
<td>3</td>
<td>90</td>
</tr>
<tr>
<td>N</td>
<td>4</td>
<td>135</td>
</tr>
<tr>
<td>S</td>
<td>5</td>
<td>270</td>
</tr>
<tr>
<td>T</td>
<td>6</td>
<td>540</td>
</tr>
<tr>
<td>U</td>
<td>7</td>
<td>810</td>
</tr>
<tr>
<td>V</td>
<td>8</td>
<td>1215</td>
</tr>
</tbody>
</table>

For Starters

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Coil Volts and Hertz</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>120/60 or 110/50</td>
</tr>
<tr>
<td>B</td>
<td>240/60 or 220/50</td>
</tr>
<tr>
<td>C</td>
<td>480/60 or 440/60</td>
</tr>
<tr>
<td>D</td>
<td>600/60 or 550/50</td>
</tr>
<tr>
<td>E</td>
<td>208/60</td>
</tr>
<tr>
<td>H</td>
<td>277/60</td>
</tr>
<tr>
<td>J</td>
<td>208-240/60 **</td>
</tr>
<tr>
<td>K</td>
<td>240/50</td>
</tr>
<tr>
<td>L</td>
<td>380-415/50</td>
</tr>
<tr>
<td>N</td>
<td>550-50</td>
</tr>
<tr>
<td>T</td>
<td>24/60, 24/50 ** ***</td>
</tr>
<tr>
<td>U</td>
<td>24/50</td>
</tr>
<tr>
<td>V</td>
<td>32/50</td>
</tr>
<tr>
<td>W</td>
<td>48/60</td>
</tr>
<tr>
<td>Y</td>
<td>48/50</td>
</tr>
</tbody>
</table>

NOTES:
* For contactor only orders, add B to end of catalog number if NEMA size 00-2, 6.
** NEMA sizes 00 and 0 only.
*** NEMA sizes 00 and 0 only. Sizes 1-8 are 24/60 only.
**** NEMA sizes 4 and 5 require the use of CTs with 1 - 5A OL relay. Size 4 starters are not shipped as assembled units. Order CH15NN01 contactor 1 - 5A OL (C440A1A0065AX or C4402A0065AX) with 60 - 300A CTs (ZEB-XCT300).

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10/10/2018
Q684 Electrical-Electronic-Control Engineering
EL-0185
Digitized Echo Sounding System

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Adaptive Digital Steering Control System Functional Block Diagram

Adaptive Digital Steering System Interface Signals

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed log input</td>
<td>Interface to external rudder servo control amplifiers</td>
</tr>
<tr>
<td>Pulsed</td>
<td>Bipolar analogue voltage proportional to the rudder order. ± 11.25 V (maximum limit) equal to ± 45° or rudder</td>
</tr>
<tr>
<td>Serial</td>
<td>Rate of turn interface</td>
</tr>
<tr>
<td>Navigator (vessel management system) input</td>
<td>Bipolar analogue voltage proportional to a turn rate indicator. ± 4.5 V (Max) equal to ± 90° turn/min. Resolution equal to 0.5°/min.</td>
</tr>
<tr>
<td>Compass</td>
<td>Data</td>
</tr>
<tr>
<td>Step data</td>
<td>$HDT$ (on channels A, B or C)</td>
</tr>
<tr>
<td>Syncro</td>
<td>Mode switch sense contact</td>
</tr>
<tr>
<td></td>
<td>External switched opened or closed to inform autopilot to change from Standby mode to an automatic mode</td>
</tr>
<tr>
<td></td>
<td>NFU sense contacts</td>
</tr>
<tr>
<td></td>
<td>External contacts to indicate when the NFU Controller is active</td>
</tr>
<tr>
<td></td>
<td>Power failure circuits</td>
</tr>
<tr>
<td></td>
<td>Closed contacts on external power switch to activate power failure alarm</td>
</tr>
</tbody>
</table>

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